Dangerous Properties of Industrial Materials

Fifth Edition

N. IRVING SAX

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phenylarsine acid. White, crystalline powder. $NH_2C_6H_4AsO(OH)_2$, mw: 217.0, mp: 232°.
Acute tox data: Oral LD_{50} (rat) = 216 mg/kg. [*3*]
THR = HIGH via oral route. See also arsenic. A grasshopper bait; a food additive permitted in the feed and drinking water of animals and/or for the treatment of food-producing animals. [*109*] See arsenic compounds and aniline. A recog carc. [*14*]
Fire Hazard: Mod. Decomp by heat to yield flam vapors.
Disaster Hazard: Dangerous; when heated to decomp or on contact with acid or acid fumes, emits highly toxic fumes of aniline and arsenic.

ARSENATE OF IRON, FERRIC. See ferric arsenate.

ARSENATE OF IRON, FERROUS. See ferrous arsenate.

ARSENIC (see also arsenic vapor). Silvery to black, brittle, crystalline and amorphous metalloid. As_4. mw: 299.64, mp: 814° @ 36 atm, bp: subl @ 615°, d: black crystals 5.724 @ 14°; black amor 4.7, vap. press: 1 mm @ 372° (sublimes).
Acute tox data: im LD_{Lo} (rat) = 25 mg/kg; sc LD_{Lo} (rabbit) = 300 mg/kg. [*3*]
THR = HIGH via im and sc routes. A poison. An exper (±) carc. [*3, 6*] Some human carc implication as well. [*6, 23, 95*] Used as a food additive in food for human consumption. [*109*] See arsenic compounds.
Radiation Hazard: For permissible levels see Table 5A.5, Section 5. Artificial isotope ^{74}As, $T_{\frac{1}{2}}$ = 18d. Decays to stable ^{74}Ge via ec and via positrons of 0.91 MeV (26%). 1.53 MeV (4%). Also decays to stable ^{74}Se via β's of 0.72 MeV (14%). 1.35 MeV (18%). Emits γ's of 0.60 and 0.63 MeV.
Fire Hazard: Mod in the form of dust when exposed to heat or flame or by chemical reaction with powerful oxidizers such as bromates, chlorates, iodates, peroxides, Li, NCl_3, KNO_3, $KMnO_4$, Rb_2C_2, $AgNO_3$, NOCl, IF_5, CrO_3, ClF_3, ClO, BrF_3, BrF_5, BrN_3, $RbC \equiv CH$, $CsC \equiv CH$. [*19*]
Explosion Hazard: Slight in the form of dust when exposed to flame.
Disaster Hazard: Dangerous; when heated or on contact with acid or acid fumes, emits highly toxic fumes; can react vigorously on contact with oxidizing materials.

***m*-ARSENIC ACID.** White crystals. $HAsO_3$, mw: 123.9, mp: decomp.
THR = See arsenic compounds.

***o*-ARSENIC ACID.** Syn: *true arsenic acid.* White, translucent crystals. $H_3AsO_4 \cdot \frac{1}{2}H_2O$, mw: 150.9, mp: 35.5°, bp: $-H_2O$ @ 160°, d: 2.0–2.5.
Acute tox data: Oral LD_{50} (rat) = 48 mg/kg; iv LD_{50} (rabbit) = 8 mg/kg. [*3*]
THR = HIGH via oral and iv routes. See arsenic compounds.

ARSENIC ACID, LIQUID. See arsenic acid.

ARSENIC ACID, SOLID. See arsenic acid.

ARSENICAL BABBITT. A bearing metal. Composition: Up to 3% As.
THR = See arsenic compounds.

ARSENICAL COMPOUNDS OR MIXTURES, N.O.S. LIQUID.
THR = See arsenic compounds.

ARSENICAL DIP, LIQUID. Syn: *sheep dip.*
THR = See arsenic compounds.
Disaster Hazard: See arsenic compounds.

ARSENICAL DUST. See arsenic.

ARSENICAL FLUE DUST. See arsenic.

ARSENICAL MIXTURE OR COMPOUNDS, N.O.S. SOLID. See arsenic compounds.

ARSENIC BISULFIDE. Syn: *arsenic sulfide, realgar.* Red-brown crystals. As_2S_2, mw: 214, bp: 565°, mp: β = 307°, d: α = 3.506 @ 19°, β = 3.254 @ 19°.
THR = See arsenic compounds and sulfides.
Fire Hazard: Mod, in the form of dust when exposed to heat or flame.
Explosion Hazard: When intimately mixed with powerful oxidizers such as Cl_2, KNO_3 chlorates.
Disaster Hazard: Dangerous, see SO_x and arsenic compounds, it will react with water or steam to produce toxic and flam vapors; can react vigorously with oxidizing materials.

ARSENIC BROMIDE. Syns: *arsenic tribromide, arsenous bromide.* Yellowish-white crystals. $AsBr_3$, mw: 314.7, mp: 32.8°, bp: 220.0°, d: 3.54 @ 25°, vap. press: 1 mm @ 41.8°.
THR = See arsenic compounds and bromides.

ARSENIC CHLORIDE. See arsenic pentachloride.

ARSENIC COMPOUNDS. Syn: *arsenicals.* Used as insecticides, herbicides, silvicides, defoliants, desiccants and rodenticides. Poisoning from arsenic compounds may be acute or chronic. Acute poisoning usually results from swallowing arsenic compounds; chronic poisoning from either swallowing or inhal. Acute allergic reactions to arsenic compounds used in medical therapy have been fairly common. The type and severity of reaction depending upon the compound of arsenic. Inorganic arsenicals are more toxic than organics. Trivalent is more toxic than pentavalent. [*89*]

CONTAMINANT PARTICULATES STRESS UPON THE AIR ENVIRONMENT. See Section 4.

CONTAMINANTS AROUND BUILDINGS DUE TO SPECIFIC METEOROLOGICAL CONDITIONS AND CROSS-CONTAMINATION BETWEEN AIR EXHAUSTS AND INLETS. See Section 4.

CONTAMINANTS IN THE WORKING PLACE AND BUILDING VENTILATION. See Sections 2 and 4.

CONTROL OF INHALATION HAZARDS BY VENTILATION. See Section 2.

COOLING AND CUTTING OILS.
THR = A recog carc. [*14*] See mineral oils.

COPAIBA. Syn: *balsam copaiba*. Transparent, viscid yellow liquid. Peculiar odor. Bitter, acrid nauseating taste. Constituents: volatile oil, resin. d: 0.93–1.00.
THR = Large doses cause vomiting and diarrhea. Can also cause dermatitis and kidney damage. Incompatible with water, magnesia, mineral acids. [*2*]

COPAL. Syns: *resin copal, gum copal*. Yellowish-brown pieces.
THR = LOW. A MILD allergen.
Fire Hazard: Slight, when heated.

COPPER. A metal with a distinct reddish color. Cu atwt: 63.5, mp: 1083°, bp: 2324°, d: 8.92, vap. press: 1 mm @ 1628°.
Acute tox data: ipLD$_{50}$ (mouse) = 3.5 mg/kg. [*3*]
THR = HIGH via ip route. See copper compounds. A (S) mutagen. [*22*]
Radiation Hazard: For permissible levels, see Section 5, Table 5A.5.
Fire and Explosion Hazard: Reacts violently with C_2H_2, NH_4NO_3, bromates, chlorates, iodates, Cl_2, ClF_3, (Cl_2 + OF_2), ethylene oxide, F_2, H_2O_2, hydrazine mononitrate, hydrazoic acid, H_2S, $Pb(N_3)_2$, K_2O_2, NaN_3, Na_2O_2. [*19*]

COPPER ABIETINATE. Syn: *cupric abietinate*. Green scales. $Cu(C_{19}H_{27}O_2)_2$, mw: 637.69.
THR = See copper compounds.
Fire Hazard: Slight, when heated.

COPPER ACETATE. Syns: *cupric acetate, neutral verdigris*. Greenish-blue, fine powder or small crystals. $Cu(C_2H_3O_2)_2 \cdot H_2O$, mw: 199.64, mp: 115°, bp: 240°, d: 1.882, (anhy): 1.93.
Acute tox data: Oral LD$_{50}$ (rat) = 710 mg/kg. [*3*]
THR = MOD via oral and inhal routes. See copper compounds.

COPPER ACETATE, BASIC. Syn: *verdigris*. Greenish-blue powder. $Cu(C_2H_3O_2)_2 \cdot CuO \cdot 6H_2O$, mw: 369.33.
THR = See copper compounds.

COPPER ACETOARSENITE. Syns: *emerald green, imperial, king's green, moss green, vienna green*. Emerald green powder. $C_4H_6O_{14}Cu_4As_6$, mw: 1013.8.
Acute tox data: Oral LD$_{50}$ (rat) = 22 mg/kg; LD$_{50}$ oral (mammal) = 18 mg/kg. [*3*]
THR = HIGH via oral and inhal routes. See arsenic compounds.

COPPER ACETONATE.
THR = See copper compounds.

COPPER ACETYLIDE. See cuprous acetylide.

COPPER AMMONIUM SULFATE. Crystals. $CuSO_4 \cdot 4NH_3 \cdot H_2O$, mw: 245.8.
THR = See copper compounds and sulfates.

COPPER ARSENATE, BASIC. Syn: *cuprous arsenate, basic*. A green solid. $Cu(CuOH)AsO_4$, mw: 283.0.
THR = See arsenic compounds and copper compounds.

COPPER ARSENIDE. Black crystals. Cu_3As_2, mw: 467.52, mp: decomp, d: 7.56.
THR = See arsenic compounds and copper compounds.
Fire Hazard: See arsine.
Explosion Hazard: See arsine.
Disaster Hazard: Dangerous; see arsenides.

COPPER ARSENITE. Syns: *cupric arsenite, Sheele's mineral*. Yellowish-green powder. $CuHAsO_3$, mw: 187.5, mp: decomp.
THR = HIGH. See also arsenic compounds.
Disaster Hazard: See arsenic compounds and copper compounds.

COPPERAS. See ferrous sulfate.

COPPER BORIDE. Syn: *cupric boride*. Yellow crystals. Cu_3B_2, mw: 212.26, d: 8.116.
THR = See copper and boron compounds.
Fire Hazard: See boron hydrides.
Disaster Hazard: Mod dangerous; on contact with acid, acid fumes, water or steam, it will react to produce toxic and flam vapors of boron hydrides.

COPPER CARBONATE HYDROXIDE. *Syn: cupric carbonate*. Green powder. $CuCO_3 \cdot Cu(OH)_2$, mw: 221.17, mp: decomp @ 200°, d: 4.0.
Acute tox data: Oral LD$_{50}$ (rat) = 159 mg/kg; oral LD$_{50}$ (birds) = 810 mg/kg. [*3*]
THR = HIGH to MOD via oral route. A fungicide. Also a trace mineral added to animal feeds. [*109*] See copper compounds.

COPPER CHELATE COMPLEX OF 8-QUINOLINOL.
THR = A (S) carc [*14*]. See also 8-hydroxy quinoline.

COPPER CHLORATE. See cupric chlorate.

COPPER CHLORIDE. Syn: *cupric chloride*. Yellowish-brown hygroscopic powder. $CuCl_2$, mw: 134.48, mp: 498°, d: 3.054.

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mine, ipecacuanic acid, psychotrine, methyl psychotaine, resin.

THR = A centrally acting emetic. Has caused fatalities. Symptoms include retention of urine, fever, diarrhea, violent abdominal pain, dehydration and cardiac irregularities. [*20*] HIGH via oral route. Can cause conjunctivitis with opacity of the cornea. See also emetine.

IPECACUANHA. See ipecac.

IPP. See diisopropyl peroxydicarbanate.

IRIDIUM AMMINE NITRATE. $Ir(NH_3)_5OH(NO_3)_3$, mw: 490.4.

THR = May be impact-sensitive; also may detonate @ red heat. [*19*]

IRIDIUM AMMINE PERCHLORATES.

THR = May be impact-sensitive. [*19*]

IRIDIUM. Slightly yellowish-white, hard brittle metal. Ir, atwt: 192.22, mp: 2410°, bp: 4130°, d: 22.65.

THR = NO data. Probably MOD via oral and inhal routes. Soluble iridium compounds are said to be toxic. However, there are no industrial data available upon which to base a maximum allowable conc in air.

Radiation Hazard: For permissible levels, see Section 5A, Table 5A.5. Artificial isotope ^{192}Ir, $T_{\frac{1}{2}}$ = 74d, decays to stable ^{192}Pt via β's of 0.24 MeV (8%), 0.54 MeV (41%), 0.67 MeV (46%) emits γ's of 0.30–0.61.

Fire Hazard: Mod, in the form of dust when exposed to heat or flame. See also powdered metals. Incandesces with OF_2 or ClF_3. Reacts violently with F_2 @ 260°. [*19*]

IRIDIUM CHLORIDE. $IrCl_3$, mw: 298.6.

Acute tox data: Iv LD_{LO} (dog) = 778 mg/kg. [*3*]

THR = MOD via oral route.

IRISH MOSS. See chondrus extract.

IROKO. See sawdust.

IRON, DUST. Syn: *ferrum*. Silvery-white, tenacious, lustrous, ductile metal. Fe, atwt: 55.8, mp: 1535°, bp: 3000°, d: 7.86, vap. press: 1 mm @ 1787°.

Acute tox data: Ip LD_{50} (mouse) = 26 mg/kg. [*3*]

THR = HIGH via ip route. Iron dust can cause conjunctivitis, choroiditis, retinitis and siderosis of tissues if iron remains in these tissues. Iron ore dust can cause palpebral conjunctivitis, massive pulmonary fibrosis and an increased incidence of lung cancer. An iron oxide fume is generated in welding operations and continued exposure to conc above 30 mg/m^3 of air can cause chronic bronchitis. Fresh iron oxide fume can cause metal fume fever. Iron compounds are susp carc of the lung, liver, connective tissue and reticuloendothelial tissue. [*14, 3*]

Radiation Hazard: For permissible levels, see Section, 5, Table 5A.5. Artificial isotope ^{55}Fe, $T_{\frac{1}{2}}$ = 2.6y, decays to stable ^{55}Mn via ec and emits x-rays. Artificial isotope ^{59}Fe, $T_{\frac{1}{2}}$ = 45d, decays to stable ^{59}Co via β's of 0.27 MeV (48%), 0.48 MeV (51%) and γ's. Emits γ's of 1.10 and 1.29 MeV.

Fire Hazard: Mod, in the form of dust when exposed to heat or flame. See also powdered metals. Reacts violently with Cl_2, ClF_3, F_2, H_2O_2, NO_2, P, Na_2C_2, H_2SO_4. [*19*]

Explosion Hazard: Mod in the form of dust when exposed to heat or flame. See also powdered metals.

To Fight Fire: Special mixtures of dry chemical.

IRON AMMONIUM CITRATE. Syn: *ferric ammonium citrate*. Thin, transparent, garnet red scales or granules or brownish-yellow powder, odorless or slight ammonia odor, sol in water, insol in alcohol.

THR = U. Used as a trace mineral added to animal feeds. [*109*]

IRON ARSENIDE. See ferric arsenide.

IRON BORIDE. Gray crystals. FeB, mw: 66.67.

THR = Details U. See boron hydrides and borides.

Fire Hazard: Mod; borides can react with moisture and acids to evolve toxic boron hydrides.

Explosion Hazard: A possible explosion hazard.

Disaster Hazard: Dangerous; can react with water, steam or acids to evolve toxic and flam fumes.

IRON CARBIDE. FeC_2, mw: 79.9.

THR = Violent reaction with Br_2, Cl_2. [*19*]

IRON CARBONATE.

THR = U. Used as a trace mineral added to animal feeds. See iron. [*109*]

IRON CARBONYL. See iron pentacarbonyl.

IRON (II) CHLORIDE. See ferrous chloride.

IRON (II) CHLORIDETETRAHYDRATE. $FeCl_2 \cdot 4H_2O$, mw: 198.8.

Acute tox data: Oral LD_{50} (rat) = 984 mg/kg; ip LD_{50} (mouse) = 93 mg/kg. [*3*]

THR = HIGH via ip and MOD via oral routes.

IRON COMPOUNDS. See corresponding ferric and/or ferrous compound.

IRON CONTAINING ASBESTOS.

THR = A susp carc for iron, a recog carc for asbestos. See iron and compounds; also asbestos. [*3, 14*]

IRON-DEXTRAN GLYCEROL GLYCOSIDE.

THR = An exper carc. [*3*]

IRON DEXTRAN COMPLEX. For human use, it is a sterile dark brown colloidal solvent, water-sol. mw: 180,000.

THR = An exper carc. A susp human carc. [*3, 6*]

Fire Hazard: Slight, when exposed to heat or flame.
Disaster Hazard: Mod dangerous; when heated to decomp, emits toxic fumes; can react with oxidizing materials.
To Fight Fire: Foam, CO_2, dry chemical.

LAURYL QUINALDINIUM BROMIDE.
THR = U. See also bromides.
Fire Hazard: U.
Disaster Hazard: Dangerous. See bromides.

LAURYL QUINOLINIUM CHLORIDE. U. A fungicide.
Fire Hazard: U.
Disaster Hazard: Dangerous. See chlorides.

LAURYL THIOCYANATE. $CH_3(CH_2)_{10}CH_2SCN$, mw: 227.3.
Acute tox data: oral LD_{50} (rat) = 1250 mg/kg. [3]
THR = MOD via oral route. An insecticide.

LAWRENCITE. See ferrous chloride.

LAWRENCIUM. A synthetic transuranium element of atomic number 103 and atomic mass 257. Lw.
THR = Radioactive.
Radiation Hazard: Intensely radioactive and therefore highly radiotoxic.

LD-813. A mixture of aromatic amines. (approx 40% MOCA).
THR = An exper carc to rats via oral route. [3]

LEACHATE PRODUCTION FROM SOLID WASTE. See Section 6.

LEAD. Syn: *plumbum*. Bluish-gray, soft metal. Pb, atwt: 207.21, mp: 327.43°, bp: 1620°, d: 11.288 @ 20°/20°, vap. press: 1 mm @ 973°.
THR = See lead compounds. A common air contaminant. It is a (S) carc of the lungs and kidney and an exper teratogen. [3, 23]
Radiation Hazard: For permissible levels, see Section 5, Table 5A.5. Natural isotope ^{210}Pb (radium-D, uranium series). $T_{\frac{1}{2}}$ = 21y. Decays to radioactive ^{210}Pb via β's of 0.0015 (19%) MeV. Emits γ's of 0.046 MeV. ^{210}Pb usually exists in equilibrium with its daughters, ^{210}Bi and ^{210}Po. Natural isotope ^{212}Pb (Thorium-B, thorium Series). $T_{\frac{1}{2}}$ = 10.6 h. Decays to radioactive ^{212}Bi via β's of 0.16 (5%), 0.34 (81%), 0.58 (14%) MeV. Emits γ's of 0.24, 0.34 MeV and x-rays.
Fire Hazard: Mod, in the form of dust when exposed to heat or flame. See also powdered metals.
Explosion Hazard: Mod, in the form of dust when exposed to heat or flame. Violent reactions with NH_4NO_3, ClF_3, H_2O_2, NaN_3, Na_2C_2, Zr. [19]
Disaster Hazard: Dangerous; when heated, emits highly toxic fumes; can react vigorously with oxidizing materials.

LEAD ACETATE. Syn: *sugar of lead*. White crystals, sol in water. Commercial grades are frequently brown or gray lumps. $Pb(C_2H_3O_2)_2 \cdot 3H_2O$, mw: 379.35, mp: 75°, anhydrous mp: 280°. d: 2.55.
Acute tox data: ip LD_{LO} (rat) = 204 mg/kg; iv LD_{50} (rat) = 120 mg/kg. [3]
THR = HIGH via ip and iv routes. See also lead compounds. A poison. An exper (+) carc and teratogen. [3, 9] Violent reaction with $KBrO_3$. [19] An insecticide.

LEAD ACETATE, BASIC. White powder.
$Pb_2OH(C_2H_3O_2)_3$, mw: 608.6.
THR = An exper (+) carc. [3, 9] See also lead acetate. A poison.

LEAD ACETATE (III) TRIHYDRATE.
THR = An exper (+) carc. [3, 9] See also lead acetate.

LEAD ANTIMONATE. Syns: *naples yellow*, *antimony yellow*. Orange yellow powder. $Pb_3(SbO_4)_2$, mw: 993.2.
THR = See lead and antimony compounds.

LEAD ARSENATES. Syn: *lead-o-arsenate*. White crystals. $PbHAsO_4$, mw: 327.1.
Acute tox data: Oral LD_{LO} (human) = 1.4 mg/kg; oral LD_{50} (rat) = 100 mg/kg. [3]
THR = HIGH via oral route. See also lead and arsenic compounds. A poison. An exper carc. [3, 9]
Disaster Hazard: Dangerous; on heating, emits highly toxic fumes.

LEAD-*m*-ARSENATE. $AsH_3O_4 \cdot (Pb)x$.
Acute tox data: Oral LD_{50} (rat) = 100 mg/kg; oral LD_{50} (mouse) = 1000 mg/kg; oral LD_{50} (rabbit) = 125 mg/kg. [3]
THR = HIGH via oral to MOD via oral routes depending upon species. See also lead arsenate. A poison.

LEAD-*o*-ARSENATE. See lead arsenates.

LEAD ARSENITE. Syns: *lead-o-arsenite*, *lead-m-arsenite*. White powder, $PbAs_2O_4$, mw: 421.
THR = HIGH. See lead compounds and arsenic compounds.
Disaster Hazard: Dangerous; on heating, emits highly toxic fumes.

LEAD-*m*-ARSENITE. See lead arsenite.

LEAD-*o*-ARSENITE. See lead arsenite.

LEAD AZIDE. Colorless needles. $Pb(N_3)_2$, mw: 291.26.
THR = See lead compounds and azides.
Fire Hazard: U.
Explosion Hazard: Severe, when shocked or exposed to heat or flame. Explodes at 250°. Violent reaction with brass, calcium stearate. CS_2, Cu, Zn. [19]
Disaster Hazard: Highly dangerous; shock and heat

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Acute tox data: Oral LD_{50} (rat) = 6750 mg/kg. [3] LD_{50} (rat) = 4500 mg/kg. [12]

THR = MOD via oral route. See also manganese compounds and carbamates. An exper teratogen and carc. [3, 12] via oral route.

Disaster Hazard: Dangerous; when heated to decomp, emits highly toxic fumes of NO_x and SO_x.

MANGANESE. Reddish-grey or silvery, brittle, metallic element. Mn, atwt: 54.93, mp: 1260°, bp: 1900°, d: 7.20, vap. press: 1 mm @ 1292°.

Acute tox data: ip LD_{50} (mouse) = 53 mg/kg; inhal TC_{LO} (human) = 11 mg/m^3 ⟶ CNS symptoms. [3]

THR = HIGH via ip and inhal routes. A known mutagen and (S) carc. [22, 23] See manganese compounds.

Radiation Hazard: For permissible levels, see Section 5, Table 5A.5. Artificial isotope ^{54}Mn, $T_{\frac{1}{2}}$ = 300d. Decays to stable ^{54}Cr by ec. Emits γ's of 0.84 MeV and x-rays.

Fire Hazard: Mod, in the form of dust or powder, when exposed to flame.

Spont Heating: No.

Explosion Hazard: Mod, in the form of dust, when exposed to flame. See also powdered metals. Violent reaction with (Al + air), Cl_2, F_2, H_2O_2, HNO_3, NO_2, P, SO_2. [19]

Disaster Hazard: Mod dangerous; will react with water or steam to produce hydrogen; can react with oxidizing materials.

To Fight Fire: Special dry chemical.

MANGANESE ACETATE. Pale red crystals, very sol in water and alcohol. $Mn(C_2H_3O_2)_2 \cdot 4H_2O$, mw: 245, d: 1.54, mp: 80°.

THR = See manganese compounds. Used as a trace mineral added to animal feeds. [109]

MANGANESE ARSENATE. Reddish-white, crystalline solid. $MnHAsO_4$, mw: 194.9.

THR = HIGH tox. See arsenic and manganese compounds.

MANGANESE BACITRACIN.

THR = U. Used as a food additive permitted in food for human consumption. [109] See also manganese compounds.

MANGANESE BENZOATE.

See manganous benzoate.

MANGANESE BROMIDE. See manganese dibromide.

MANGANESE CACODYLATE. Reddish-white crystals. $Mn[(CH_3)_2AsO_2]_2$, mw: 328.9.

THR = HIGH. See arsenic and manganese compounds.

MANGANESE CHLORIDE.

See manganese dichloride.

MANGANESE COMPOUNDS.

THR = Chronic manganese poisoning is a clearly characterized disease which results from the inhal of fumes or dusts of manganese. Exposure to heavy conc of dusts or fumes for as little as three months may produce the condition, but usually cases develop after 1–3 yrs of exposure. The CNS is the chief site of damage. If cases are removed from exposure shortly after the appearance of symptoms, some improvement in the patient's condition frequently occurs, though there may be some residual disturbances in gait and speech. When well established, however, the disease results in permanent disability.

Individuals exposed to dusts and fumes of manganese have been reported by several investigators to suffer from a much higher incidence of upper respiratory infections and pneumonia than does the general population. It has not yet been possible to prove that a definite pneumonitis results in humans from exposure to manganese dusts or fumes under industrial conditions. However, experiments with mice have produced definite and striking lung pathology which varied in intensity with the length of exposure to the dust.

Chronic manganese poisoning begins usually with complaints of languor and sleepiness. This is followed by weakness in the legs and the development of a stolid, mask-like facies, and the patient speaks with a slow monotonous voice. Then muscular twitchings appear, varying from a fine tremor of the hands to coarse, rhythmical movements of the arms, legs and trunk. Nocturnal cramps of the legs appear about the same time. There is a slight increase in tendon reflexes, ankle and patellar clonus, and a typical Parkinsonian slapping gait. The handwriting may be quite minute. There are no sensory disturbances, and no eye, gastrointestinal or genitourinary complaints. The urine and spinal fluid are normal, and the blood shows no abnormality or only a slight leucopenia. The symptoms may simulate progressive bulbar paralysis, postencephalitic Parkinsonism, multiple sclerosis, amyotrophic lateral sclerosis and progressive lenticular degeneration (Wilson's Disease). An exper (+) carc. [12, 14, 23, 117] Often a history of exposure is the only aid in establishing the diagnosis. The blood may show increased erythrocyte formation and increased osmotic fragility. Early administration of EDTA can hasten recovery, but it is of little value in cases of long standing.

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SILICONES. Syn: *siloxanes*. Organosilicon oxide polymers such as $-R_2Si-O-$ where R is a monovalent organic radical.
THR = Generally LOW. Most of the silicones that have been studied should have low toxicity or none at all and little or no irr effects. May be spont flam in air. [*19*]

SILICON FLUORIDE. See silicon tetrafluoride.

SILICON HYDRIDES. See silanes.

SILICON MONOSULFIDE. Yellow needles or black solid. SiS, mw: 60.13, bp: 940° @ 20 mm (sublimes), d: 1.854 @ 15°.
THR = No data. See also sulfides.

SILICON MONOXIDE. Solid, insol in water, sol in alkalis and hydrofluoric acid. SiO, mw: 44.1, d: 2.2, mp: > 1700°, bp: 1880°.
THR = U. Self-ignites in air. [*19*]

SILICON NITRIDE. $(Si_2N_2)_x$.
THR = Self-ignites in air. [*19*]

SILICON OXYHYDRIDE. White powder, insol in water. $(Si_2H_2O_3)_x$, mw: $(104.2)_x$, mp: 1635°.
THR = U. See also silica.

SILICON SODIUM FLUORIDE. Na_2SiF_6, mw: 188.1.
Acute tox data: Oral LD_{50} (rat) = 125 mg/kg; sc LD_{LO} (frog) = 448 mg/kg. [*3*]
THR = HIGH via oral; MOD via sc routes. See also fluosilicates and fluorides.

SILICON TETRAACETATE. Hygroscopic crystals. $Si(C_2H_3O_2)_4$, mw: 264.24, mp: 110°, bp: 148° @ 6 mm.
THR = Violent reaction with water. A powerful irr. No data.

SILICON TETRAAZIDE. $Si(N_3)_4$, mw: 197.2.
THR = Has exploded spont. [*19*] See also azides.

SILICON TETRABROMIDE. See silicon bromide.

SILICON TETRACHLORIDE. See silicon chloride.

SILICON TETRAFLUORIDE. Syn: *tetrafluorosilane*. Colorless gas, very pungent odor. SiF_4, mw: 104.1, mp: −77°, bp: −65° @ 181 mm, d: 4.67 g/liter.
THR = HIGH. See fluorides and hydrofluoric acid.

SILICON TETRAIODIDE. Syn: *tetraiodosilane*. Cubic, colorless crystals. SiI_4, mw: 535.74, mp: 120.5°, bp: 288°, d: 4.2.
THR = No data. Probably irr and toxic. See also iodides.
Disaster Hazard: Dangerous; when heated to decomp, emits toxic fumes of iodides; will react with water or steam to produce toxic and corrosive fumes.

SILICON TETRATHIOCYANATE. Small prisms. $Si(SCN)_4$, mw: 260.40, mp: 143.8°, bp: 314.2°.
THR = No data. See also thiocyanates.

SILICON TRICHLORIDE HYDROSULFIDE. Colorless liquid. $SiCl_3HS$, mw: 167.51, bp: 96°–100°, d: 1.45.
THR = See sulfides and chlorides.

SILICYL OXIDE. Syn: *disiloxane*. Colorless gas. $(SiH_3)_2O$, mw: 78.17, mp: −144°, bp: −15.2°, d: 0.881 @ −80°.
THR = No data. Probably an irr. See also sulfides and hydrochloric acid.
Fire Hazard: Easily self-ignites in air. [*19*]

SILK DUST.
Acute tox data: imp TD_{LO} = 30 mg/kg ⟶ carc. [*3*]
THR = An allergen and nuisance dust. An exper carc via imp route. [*3*]
Fire Hazard: Mod, when exposed to flame; can react with oxidizing materials.
Explosion Hazard: Mod, in the form of a dust cloud, when exposed to flame.

SILOXANE. See silicones.

SILVER. Syn: *argentum*. Soft, ductile, malleable, lustrous, white metal. Ag, atwt: 107.88, mp: 961.93°, bp: 2212°, d: 10.50 @ 20°.
THR = See silver compounds. An exper neo by implantation route. [*3*]
Radiation Hazard: For permissible levels, see Section 5A, Table 5A.5. Artificial isotope ^{110m}Ag, $T_{\frac{1}{2}}$ = 253d, decays to stable ^{110}Cd via β's of 0.085 (61%), 0.53 (36%) MeV; emits γ's of 0.66 to 1.50 MeV.
Fire Hazard: Mod, in the form of dust, when exposed to flame or by chemical reaction with C_2H_2, NH_3, bromoazide, ClF_3, ethylene imine, H_2O_2, oxalic acid, H_2SO_4, tartaric acid. [*19*] See also powdered metals.

SILVER ACETATE. White plates. $AgC_2H_3O_2$, mw: 166.92, mp: decomp, d: 3.259 @ 15°.
THR = See silver compounds.

SILVER ACETYLIDE. White precipitate. Ag_2C_2, mw: 239.78, mp: explodes.
THR = See silver compounds.
Fire Hazard: U.
Explosion Hazard: Severe, when shocked or exposed to heat. See acetylides. Very sensitive explosive.
Disaster Hazard: Dangerous; shock or heat will explode it.

SILVER AMALGAMS. Silvery liquid or solid. Ag + Hg.
THR = See mercury and silver.

SILVER AMMONIUM COMPOUNDS.
THR = See silver compounds.
Explosion Hazard: Severe, when shocked, exposed to heat or by chemical reaction.

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Z

ZEARALENONE. $C_{18}H_{22}O_5$, mw: 318.4.
THR = An exper carc [*23*]

ZEOLITE. A hydrated alkali aluminum silicate, capable of exchanging alkali for calcium and magnesium; used for softening water. There are a number of artificial zeolites now on the market. $Na_2O \cdot Al_2O(SiO_2)_4 \cdot (H_2O)_x$.
THR = A nuisance dust. See nuisance dusts. May be alkaline on contact with tissue moisture. LOW via oral route. [*20*]

ZEPHIRAN CHLORIDE. See benzalkonium chloride.

ZERO TOLERANCE CONCEPT. [*109*]

ZINC. A bluish-white lustrous metal. Zn, atwt: 65.38, mp: 419.58, bp: 907°, d: 7.133 @ 25°, vap. press: 1 mm @ 487°.
Acute tox data: ip LD_{50} (mice) = 15 mg/kg. [*3*]
THR = HIGH via ip route. See also zinc compounds.
Radiation Hazard: For permissible levels, see Section 5A, Table 5A.5. Artificial isotope ^{65}Zn, $T_{\frac{1}{2}}$ = 245d, decays to stable ^{65}Cu by ec; emits γ's of 1.12 MeV and x-rays.
Fire Hazard: Mod, in the form of dust when exposed to heat or flame.
Spont Heating: No.
Explosion Hazard: In the form of dust when reacted with acids, NH_4NO_3, BaO_2, $Ba(NO_3)_2$, Cd, CS_2, chlorates, Cl_2, ClF_3, CrO_3, (ethyl acetoacetate + tribromoneopentyl alcohol), F_2, hydrazine mononitrate, hydroxylamine, $Pb(N_3)_2$, (Mg + $Ba(NO_3)_2$ + BaO_2), $MnCl_2$, HNO_3, performic acid, $KClO_3$, KNO_3, K_2O_2, Se, $NaClO_3$, Na_2O_2, S, Te, H_2O. [*19*] See also powdered metals.
To Fight Fire: Special mixtures of dry chemical.

ZINC ACETATE. Monoclinic crystals. $Zn(C_2H_3O_2)_2$, mw: 183.47, mp: 242°, bp: sublimes in vacuum, d: 1.84.
Acute tox data: Oral LD_{50} (rat) = 2460 mg/kg. [*3*]
THR = MOD via oral route. See zinc compounds. A trace mineral added to animal feeds. [*109*]

ZINC ACETONYL ACETONATE.
Acute tox data: ip LD_{50} (rat) = 50 mg/kg. [*3*]
THR = HIGH via ip route. See also zinc compounds.

ZINC ALKYL AMINE *o*-PHENYL PHENATE.
THR = U. See phenols and zinc compounds. A fungicide.
Disaster Hazard: Dangerous; when heated to decomp, emits high toxic fumes.

ZINC ALLYL DITHIOCARBAMATE.
Acute tox data: Oral LD_{50} (rat) = 375 mg/kg; oral LD_{50} (mice) = 440 mg/kg. [*3*]
THR = HIGH via oral route. See also carbamates and zinc compounds.

ZINC AMIDE. Amorphous, white powder. $Zn(NH_2)_2$, mw: 97.43, mp: decomp @ 200°, d: 2.13 @ 25°.
THR = Can react violently with hydrazine. [*19*] See zinc compounds.

ZINC AMMONIUM NITRITE. Solid. $ZnNH_4(NO_2)_3$, mw: 221.5.
THR = See nitrites and zinc compounds.
Fire Hazard: Mod, by spont chemical reaction. A powerful oxidizing agent.
Explosion Hazard: U.
Disaster Hazard: See nitrites.

ZINC ARSENATE. White, odorless powder. Compositions: variable; approx $5ZnO$, $2As_2O_5$.
THR = A poison. See arsenic and zinc compounds.

ZINC-*o*-ARSENATE. Monoclinic crystals.
$Zn_3(AsO_4)_2 \cdot 8H_2O$, mw: 618.09, mp: decomp @ 100°, d: 3.309 @ 15°.
THR = See arsenic and zinc compounds.

ZINC ARSENIDE. Cubic crystals. Zn_3As_2, mw: 345.96.
THR = HIGH. See zinc and arsenic compounds.
Fire Hazard: Mod; can evolve arsine upon contact with moisture or acid; see also arsine.
Explosion Hazard: Mod; can evolve arsine upon contact with moisture or acid; see also arsine.
Disaster Hazard: Dangerous; when heated to decomp, or on contact with acid or acid fumes, emits highly toxic fumes of arsenic.

ZINC ARSENITE. See zinc-*m*-arsenite.

ZINC-*m*-ARSENITE. Syns: *ZMA*, *zinc arsenite*. White powder. $Zn(AsO_2)_2$, mw: 279.2.
THR = HIGH. A wood preservative, insecticide. See arsenic compounds; also see zinc compounds.

ZINC ASHES. See zinc.

ZINC BACITRACIN. Creamy white powder, slightly sol in water.
THR = U. An additive permitted in food for human consumption. Also permitted in the feed and drinking water of animals and/or for the treatment of food-producing animals. [*109*]